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X-ray Study of the Electric Double Layer at the n-Hexane/Colloidal Silica Interface
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Beamline(s): X19C

Introduction: The concept of the electrical double layer is the basis for the various theoretical aspects of physical chemistry and the structure of liquid/metal and liquid/liquid interfaces (see, for example Ref.1,2). The structure of the insulator/electrolyte solution interface has a fundamental importance for the description of electrochemical processes in systems where membranes, absorbers, catalysts, surfactants or surfaces of other dielectrics are involved. In this work I have utilized x-ray synchrotron radiation to demonstrate the charge separation at n-hexane/silica sol interface and to study the structure of the electrical double layer.

Methods and Materials: The interface between concentrated colloidal silica suspensions with 50, 70 and 120 Angstrom particles and n-hexane was studied. I used x-ray reflectivity to obtain the electron-density profile across the interface with the resolution down to 20 Angstrom.

Results: The profile (see figure) consists of three layers, i.e. the compact layer of Na^+, the diffuse layer and the low-density layer between them. The concentration of the sodium ions adsorbed at the hexane surface in the compact layer is as much as 10^{19} m^{-2}. A monolayer of tightly packed colloidal particles occurs to be a part of the diffuse layer. The monolayer density exceeds significantly the suspension bulk density (by 2 times for 50 Angstrom particle sol). The low-density region between the compact and the diffuse layers is as wide as two diameters of the particle. The energy of 'image forces', which was evaluated from the experimental data, agrees well with the theory (Ref 3).

References:
1. A.W. Adamson, “Physical Chemistry of Surfaces”, 3d edition, John Wiley & Sons, Inc, New-York (1976).
2. A.G. Volkov, D.W. Dreamer, D.L. Tanelli, and V.S. Markin, “Progress in Surface Science”, **53**, 1 (1996).
3. M.A. Vorotyntsev and S.N. Ivanov, “Russ. J. of Electrochem.”, **25**, 491 (1989).

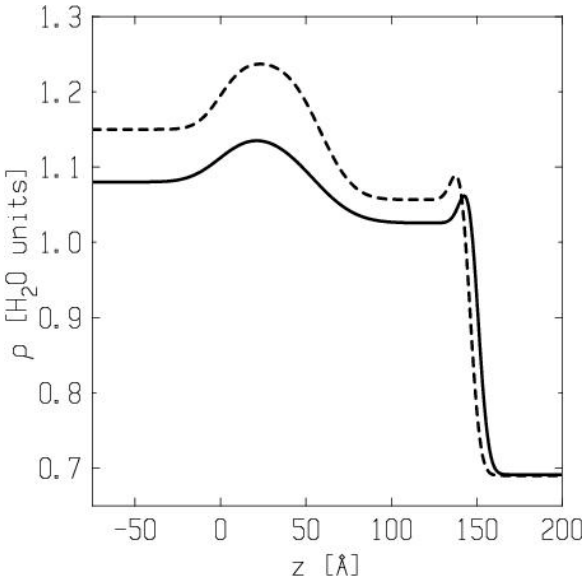

Figure. The normalized profile of the electron-density across the n-hexane/silica sol interface based on the model with the compact layer for the 50 Angstrom particle suspension (solid line) and for the 70 Angstrom particle suspension (dash-dot line).